Investigation of metallic contaminations found in vector- and mRNA-based COVID-19-"vaccines" - Preliminary results -

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1 Summary

Different vials of mRNA-based COVID-19-"vaccines" (Biontech and Moderna) are investigated by means of Scanning Electron Microscopy (SEM) and corresponding Energy Dispersive X-ray Spectroscopy (EDX) to study potential contaminations. Metallic particles comprising transition metals (e.g. cobalt (Co), iron (Fe), chromium (Cr), titanium (Ti)), rare earth metals such as cerium (Ce) and gadolinium (Gd), barium (Ba), caesium (Cs), aluminium (Al), silicon (Si), sulfur (S), potassium (K) and calcium (Ca) are found. The size of the particles varies from 1μm to 100μm. In contrast, first investigations of the compounds of Johnson&Johnson (Janssen), Lubecavax, and Influspit Tetra yielded did not show signs of such contaminations and particles up to now. However, further confirmation and measurements are necessary and planned for the near future.

2 Experimental section

Different samples of COVID-19-"vaccines" are investigated by SEM/EDX. In a scanning electron microscope (SEM), the sample in question is scanned by means of a narrowly focused electron beam (5-10nm) of several thousand electron volts energy. In the studies presented here, energy of 15000 eV (15 keV) was used, and secondary electrons were used for imaging. In addition to imaging the surface of the sample at very high resolution, chemical analysis can be performed using energy dispersive X-ray spectroscopy (EDX). At the energy of 15 keV used here, a detection depth of some micrometers is achieved.

The samples were leftovers from vials which could not be used for injection anymore or vials where the cooling chain was interrupted. The samples were prepared for REM/EDX in two different ways. Firstly, a number of microscope slides were covered with a thin film of Gold (Au) for electrical conductivity required for the measurements. The vaccine samples have been drawn up with syringes exactly as it is done before injecting person to be vaccinated. Then, the vaccine samples were dripped from the syringe onto the Au covered slide. The vaccine dried for several days under ambient conditions protected from any contamination, before the samples were brought into the SEM. Secondly, other lots of COVID-19-"vaccines" were prepared in a different lab. Here, the vials were opened and the samples were directly casted onto microscope slides, were the samples dried for several days under ambient conditions protected from contamination. Then, the samples were sent to the SEM-lab. Since these microscope slides were not covered with Au,

the slides were covered with a thin iridium (Ir) film prior to the SEM/EDX measurements to ensure the required electrical conductivity. Note that the EDX detector used contains a carbon based window, hence the signals from carbon and oxygen in the EDX-spectra are not entirely reliable.

3 Results

The following reference sample, a sample of the protein based vaccine Lubecavax, and a number of lots of novel COVID-19-"vaccines" have been studied with SEM/EDX:

- an empty microscope slide as reference
- Lubecavax (Prof. Stöcker)
- AstraZeneca (Vaxzevria): lot 210101 and lot 1423474
- Biontech-Pfizer (Cormirnaty) lot FE7011, lot FE8045, and lot 1F1010A
- Moderna (Spikevax), lot 3004217

3.1 Empty microscope slide

Figure 1 shows a SEM image of several mm^2 area of an empty microscope slide taken directly from the original packaging. The slide was covered with a thin film of Ir to ensure electrical conductivity directly before measurement The slide is homogenous with a few microscopic scratches. The EDX-map indicates also a homogenous distribution of the chemical elements identified in the EDX-spectrum, i.e. Na), Mg, Al, K, Ca, and the main component is Si (likely SiO_2).

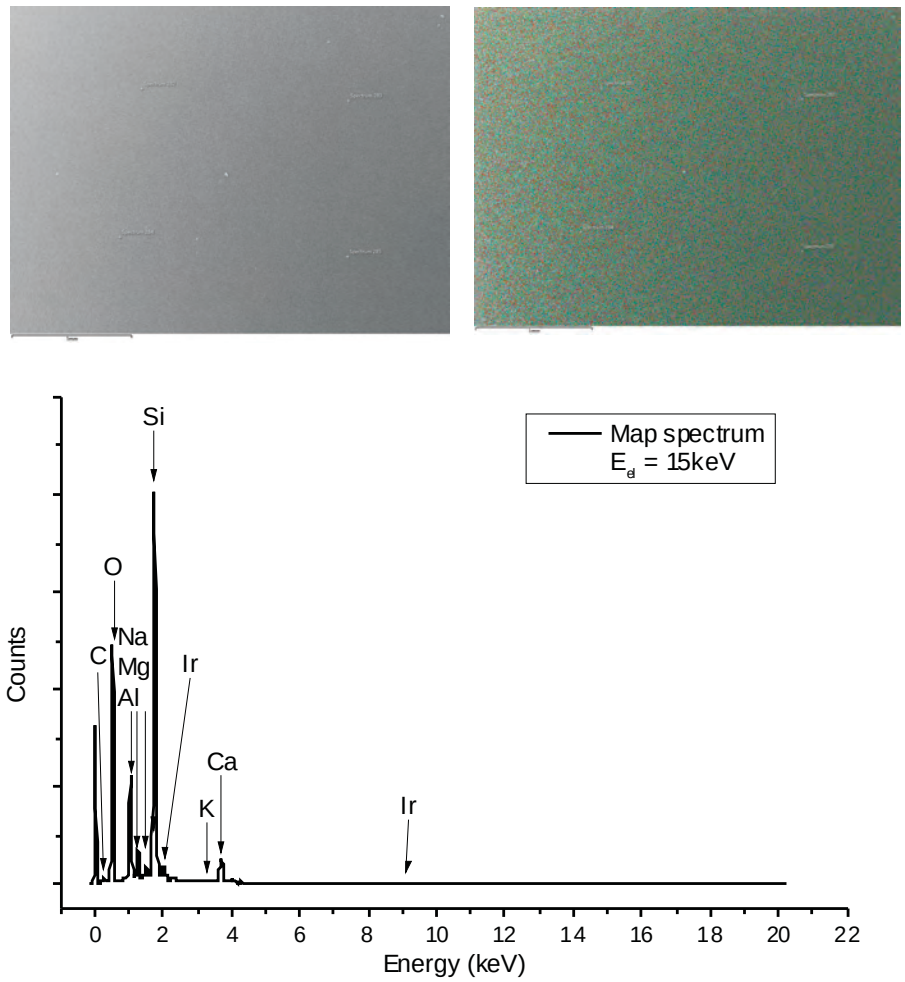

Figure 1: Top left: SEM image of an empty microscope slide. Top right: EDX map. Bottom: EDX sum spectrum of the mapped area.

3.2 Lubecavax

This sample was prepared in another lab for SEM/EDX-experiments. In this case the sample holder was covered with a thin platinum (Pt) film prior to the SEM/EDX measurements to ensure the required electrical conductivity. Figure 2 displays a typical SEM image of the protein component of Lubecavax. The EDX-point spectra show a spot with more Na and chlorine (Cl) (likely NaCl) (spot1) and a spot with more organic components (spot4), Except low amounts of S and K no other contaminations are found.

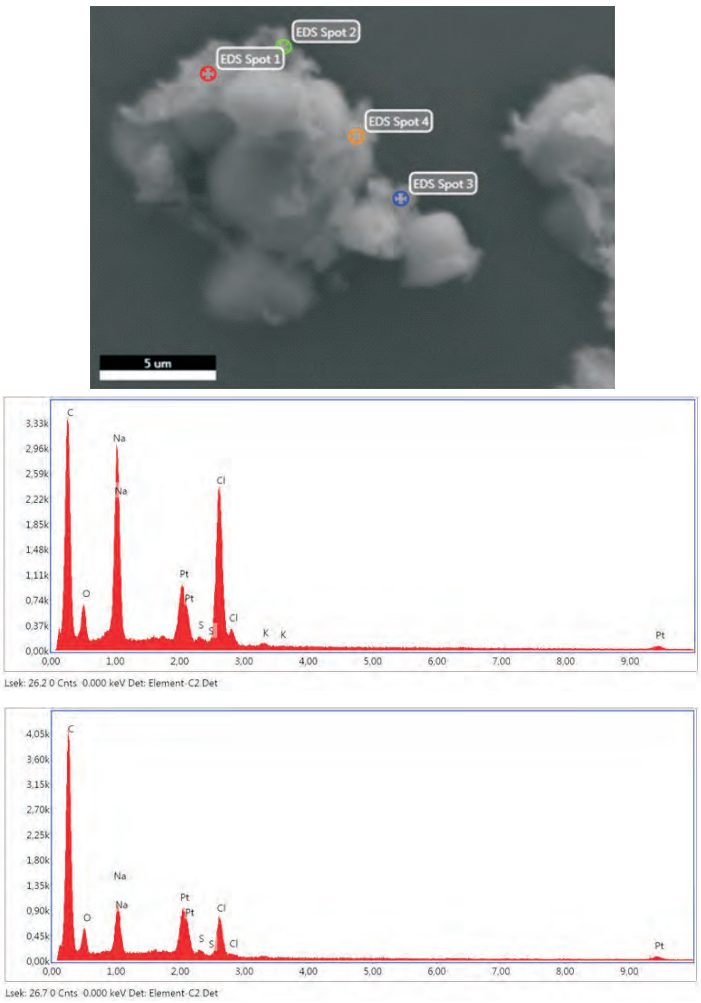

Figure 2: Top: SEM image of the dried protein component of Lubecavax-vaccine. Center and bottom: EDX point spectra of dried vaccine (spots 1 and 4). Note that Pt does not belong to the sample probed by EDX due to the sample preparation described above.

3.3 AstraZeneca (Vaxzevria: lot 210101)

This sample was prepared via a syringe on a gold covered microscope slide as described in section 2. The EDX-spectrum shown in Fig.3 is typical for the dried Vaxzevria-"vaccine", it consists of some Na und Cl (likely NaCl) and mainly of organic ingredients.

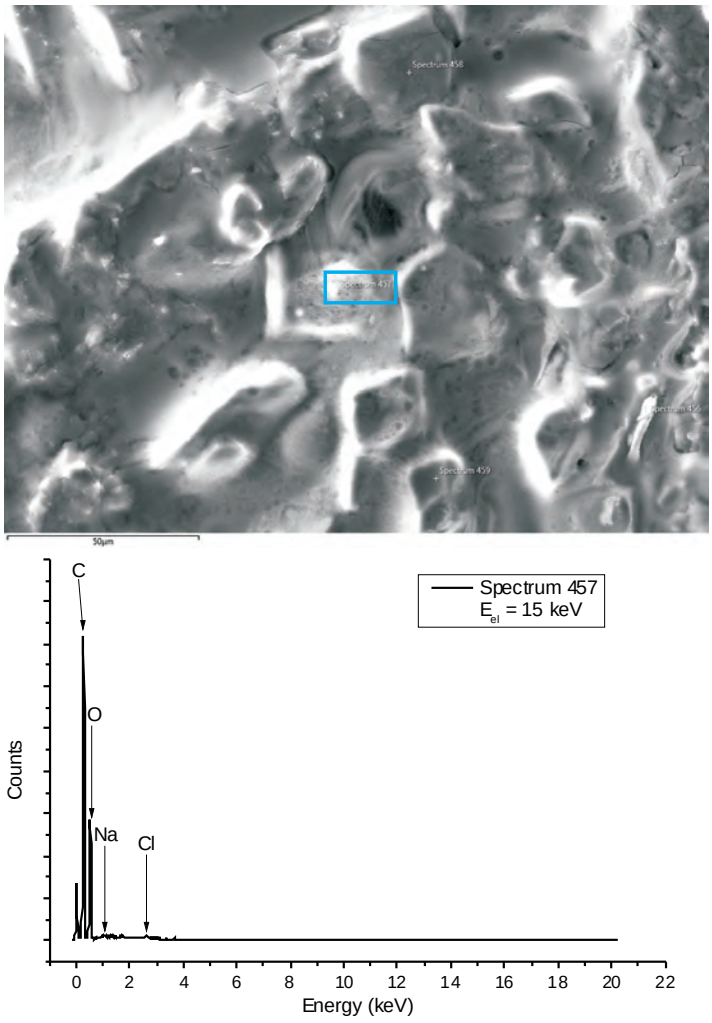

Figure 3: Top: SEM image of dried vaccine. Bottom: EDX point spectrum of dried vaccine (site 457), marked by a blue frame.

Figure 4 shows a SEM image of a contamination found in this sample. An EDX point spectrum taken at site 616 (c.f. Fig 4) reveals the presence of silver (Ag) as well as traces of S, Co, Ce and Gd localized in this contamination. The other point scans taken yield in similar results. The surrounding material is the organic part of the "mRNA-vaccine" exposed to the electron radiation.

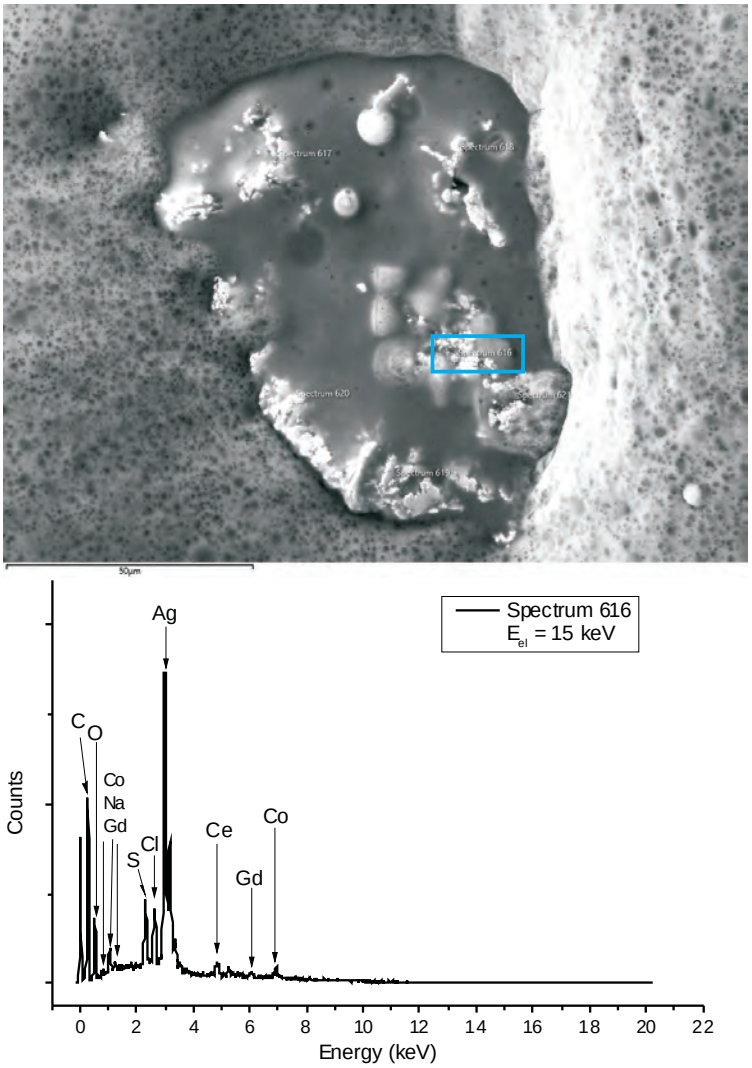

Figure 4: Top: SEM image of a contamination. Bottom: EDX point spectrum of site 616 (marked by a blue frame).

3.4 AstraZeneca (Vaxzevria: lot 1423474)

This sample was prepared at another lab opening the vial and then preparing the sample as described in section 2. Figure 5 shows a SEM image of a contamination found in this sample. An EDX point spectrum taken at site 616 (c.f. Fig 5) reveals the presence of Al and S, but also Ca, Fe, and Ti present in this contamination. The other point scans taken yield in similar results.

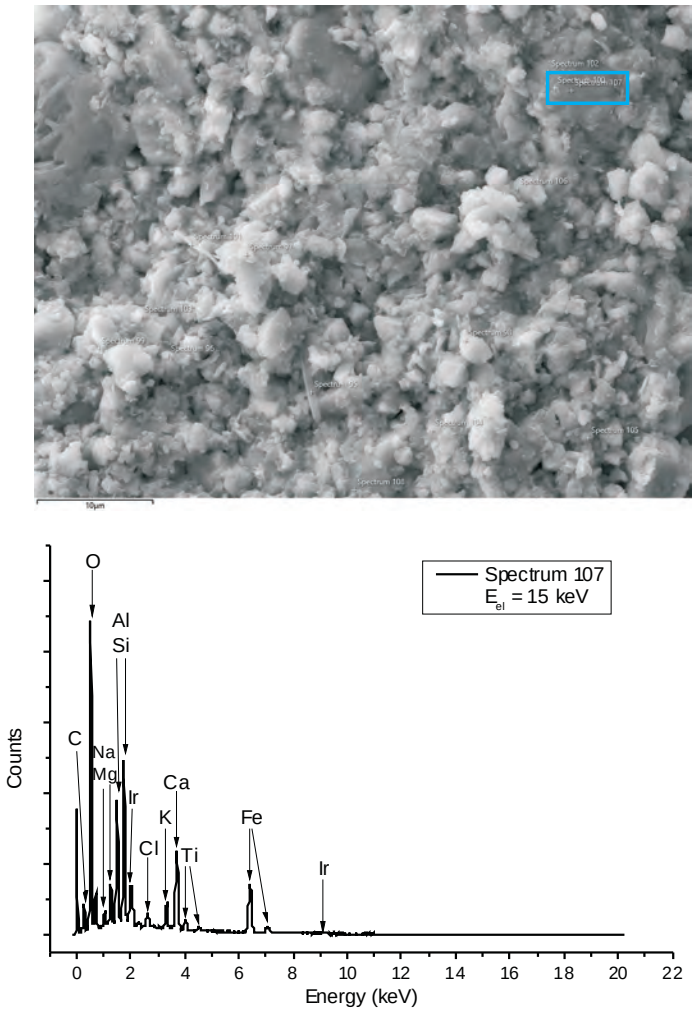

Figure 5: Top: SEM image of a contamination. Bottom: EDX point spectrum of site 107 (marked by a blue frame). Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

3.5 Biontech-Pfizer (Cormirnaty: lot FE7011)

This sample was prepared via a syringe on a gold covered microscope slide as described in section 2. The EDX-spectrum shown in Fig.6 is typical for the dried Cormirnaty-"vaccine", it consists mainly of Na und Cl (likely NaCl), phosphorus (P), which may stem from some of the lipids, and organic ingredients.

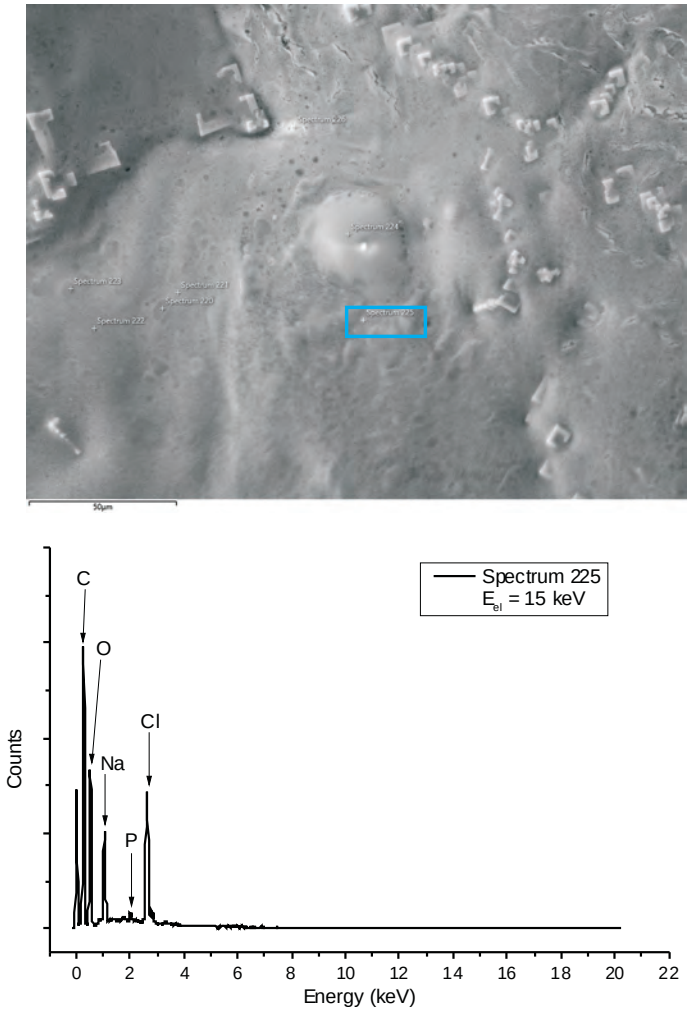

Figure 6: Top: SEM image of dried vaccine including contamination in the center. Bottom: EDX point spectrum of dried vaccine (site 225), marked by a blue frame.

Figure 7 displays a SEM image of a contamination consisting of Si only as can bee seen from the corresponding EDX-spectrum.

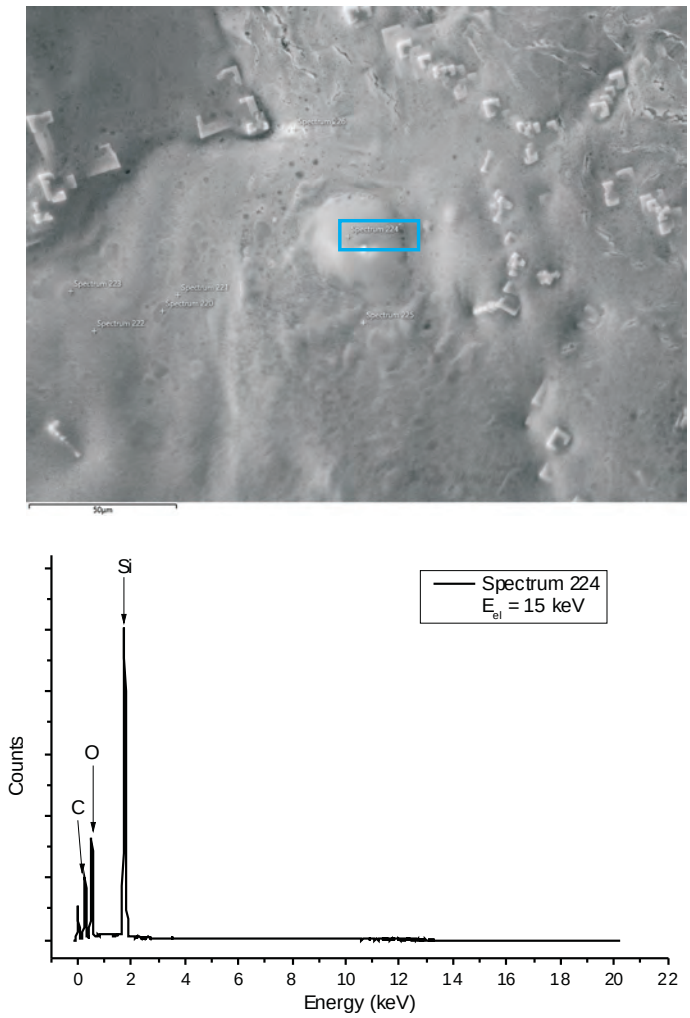

Figure 7: Top: SEM image of dried vaccine and a Si-contamination in the center. Bottom: EDX point spectrum of the Si (site 224), marked by a blue frame.

Figure 8 displays an Fe-containing particle found in this sample. The particles dimensions are $\approx 2.5\mu$m $\times$ 2.0μm

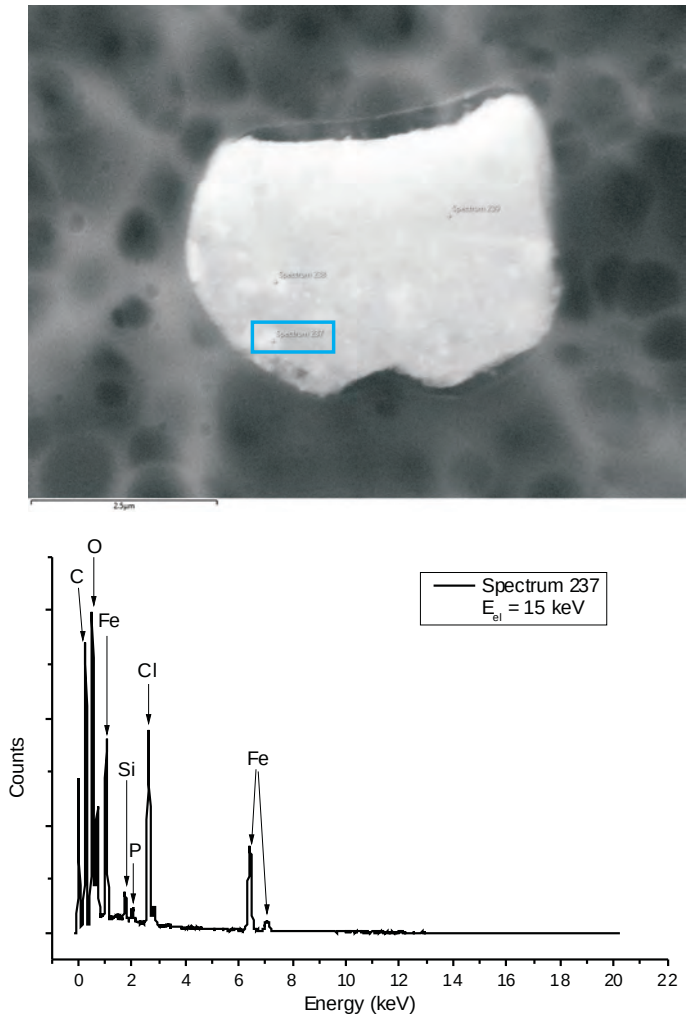

Figure 8: Top: SEM image of a 2.5μm wide contamination. Bottom: EDX point spectrum of the Fe containing particle (site 237), marked by a blue frame.

3.6 Biontech-Pfizer (Cormirnaty: lot FE8045)

This sample was prepared at another lab opening the vial and then preparing the sample as described in section 2. Figure 9 shows a SEM image of a contamination consisting mainly of Ca, traces of Si are also present.

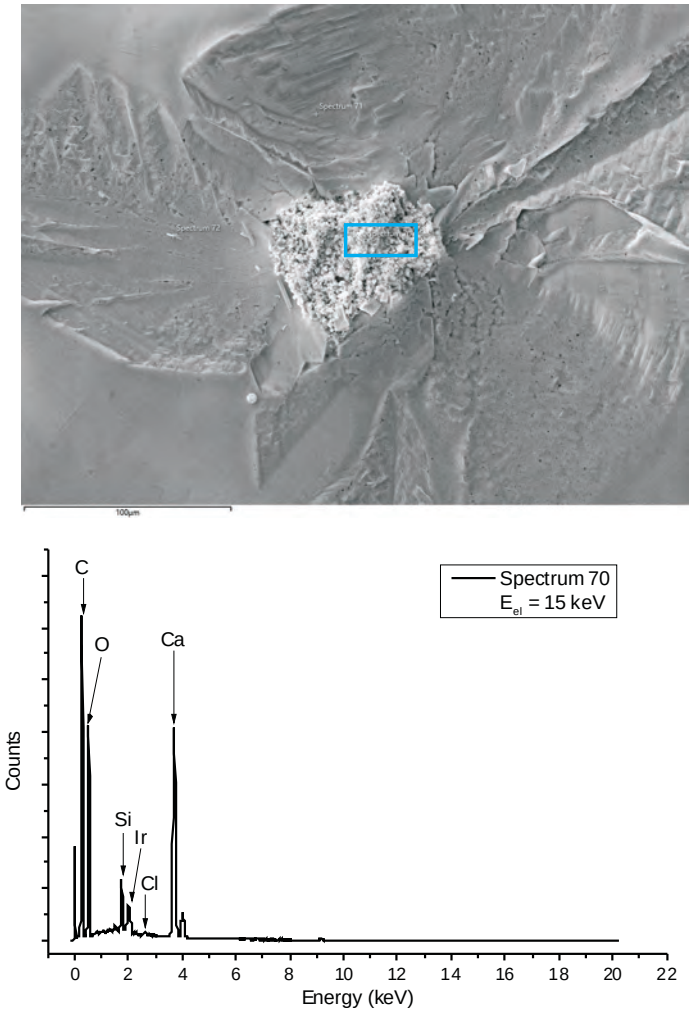

Figure 9: Top: SEM image of a contamination of 40-50μm size. Bottom: EDX point spectrum of this contamination (site 70), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

Figure 10 shows a SEM image of a contamination comprising a number of chemical elements. Besides Mg, Al, Si, S, K, and Ca also the 3d transition metals Ti and Fe are detected. The other point spectra recorded at this contamination yield to similar results in terms of the elements detected, with partly changing stoichiometry.

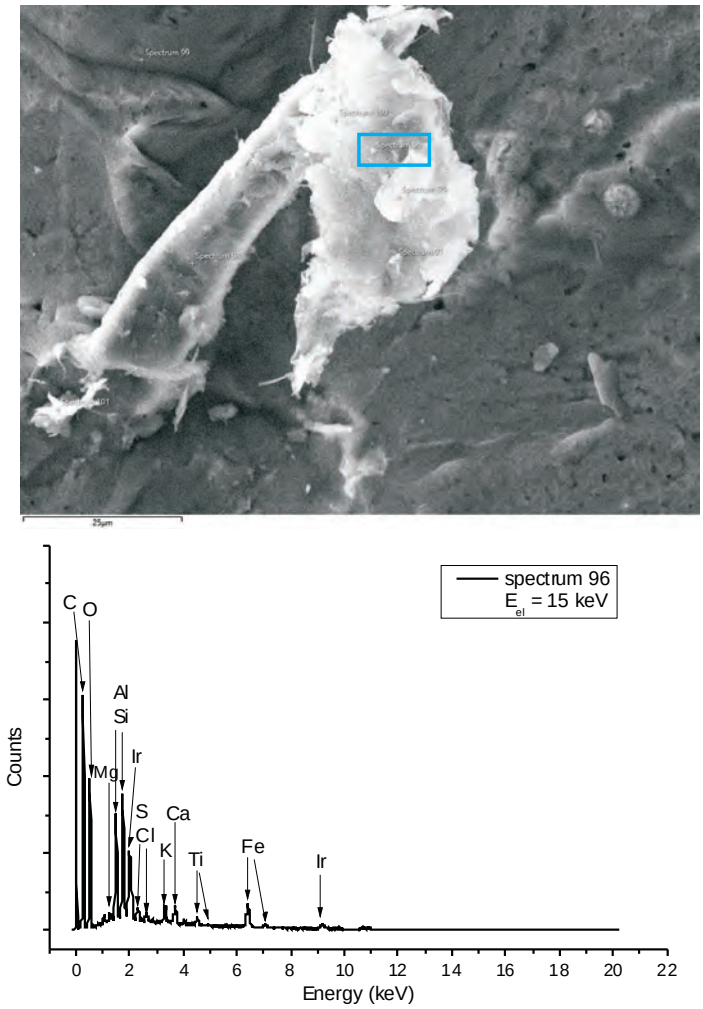

Figure 10: Top: SEM image of a contamination of 25-30μm size. Bottom: EDX point spectrum of this contamination (site 96), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

Figure 11 (top left) shows a SEM image of a particle in the form of a sphere. This sphere consists mainly of Al, some Ca and traces of Fe are also present as can be seen from the element specific spatial EDX mapping results.

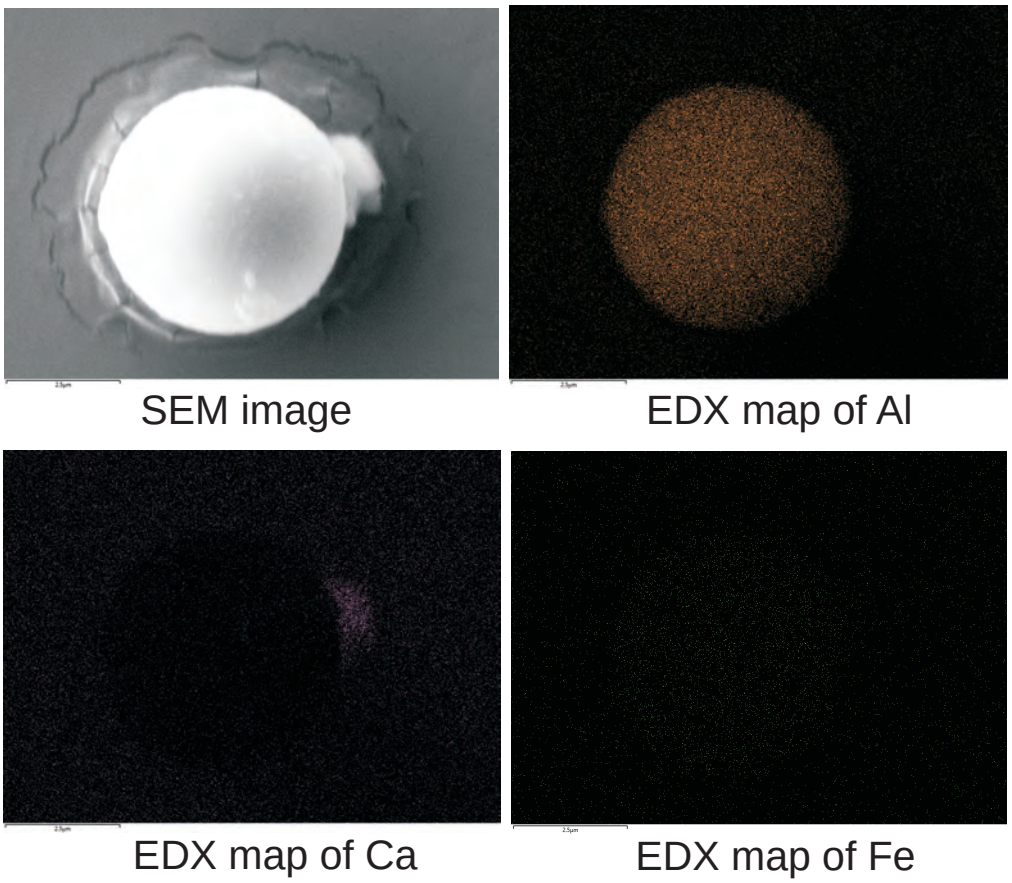

Figure 11: Top left: SEM image of a sphere of 3μm diameter. Top right: Element specific EDX mapping of Al. Bottom: element specific EDX mappings of Ca and Fe.

3.7 Biontech-Pfizer (Cormirnaty: lot 1F1010A)

This sample was prepared at another lab opening the vial and then preparing the sample as described in section 2. Figure 12 shows a SEM image of a contamination consisting mainly of S, Some Fe is also present. Furthermore, traces of Na, Al, Si, and Ca are detected. The other point scans taken yield in similar results, with partly changing stoichiometry.

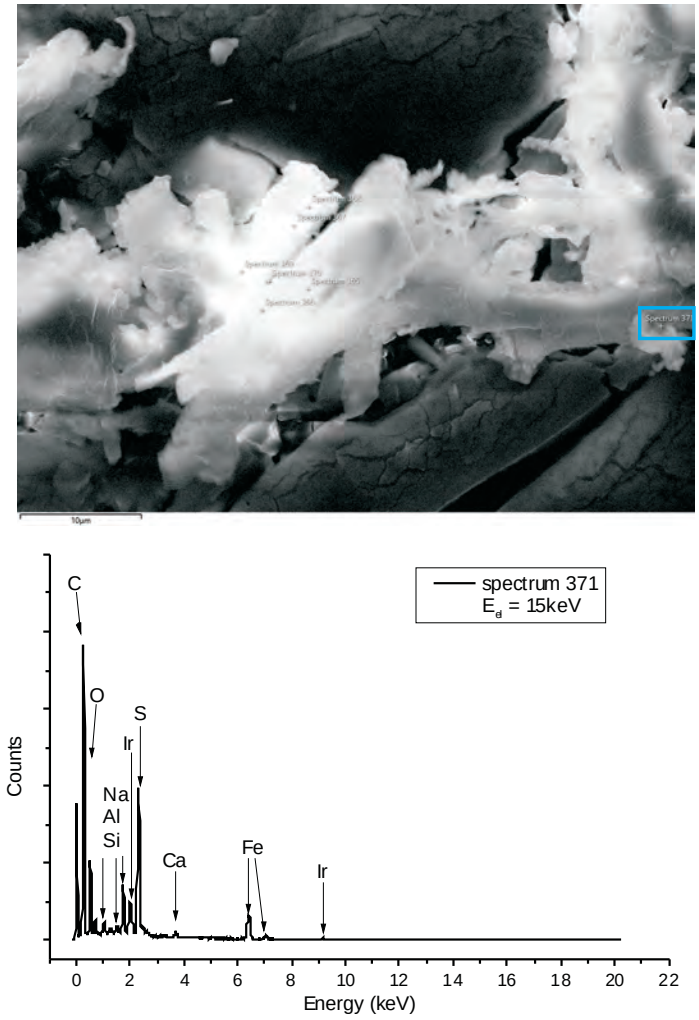

Figure 12: Top: SEM image of a contamination of 40μm $\times$ 10μm size. Bottom: EDX point spectrum of this contamination (site 371), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

Figure 13 shows a SEM image of a contamination comprising significant amounts of Ti, traces of Na, Al, Si, S, and Ca are also detected.

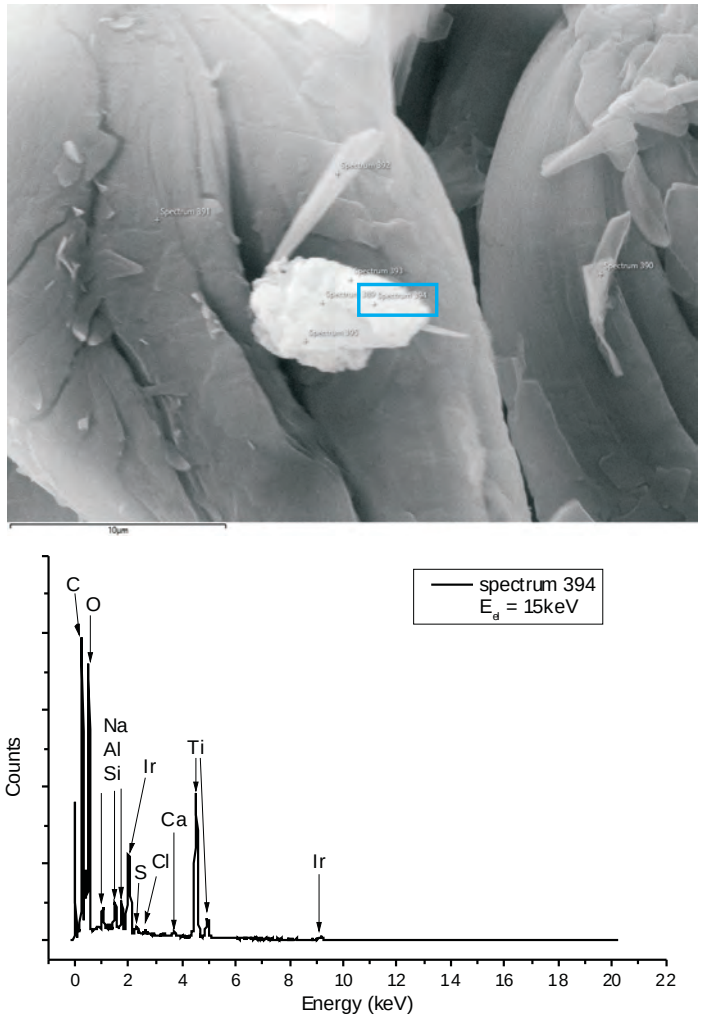

Figure 13: Top: SEM image of a particle of 5μm size. Bottom: EDX point spectrum of this particle (site 394), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

3.8 Moderna (Spikevax: lot 3004217)

This sample was prepared via a syringe on a gold covered microscope slide as described in section 2. The EDX-spectrum shown in Fig.14 is typical for the dried Spikevax-"vaccine", it consists of Na und Cl (likely NaCl), traces of P, which may stem from some of the lipids, and manly, organic ingredients.

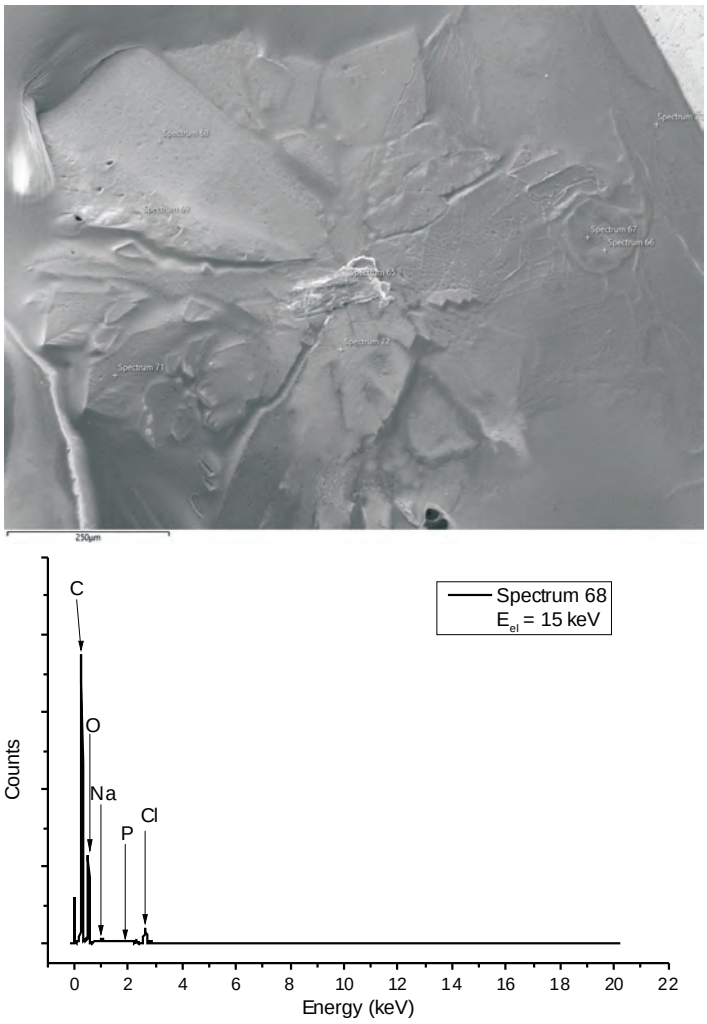

Figure 14: Top: SEM image of dried vaccine. Bottom: EDX point spectrum of dried vaccine (site 68), marked by a blue frame.

This sample was prepared via a syringe on a gold covered microscope slide as described in section 2. Figure 15 shows a SEM image of a contamination comprising significant amounts of Si. Besides traces of Na, Mg, Al, P, S, Cl, and Ca also the metals Cs, Cr ,Fe , and copper (Cu) are detected.

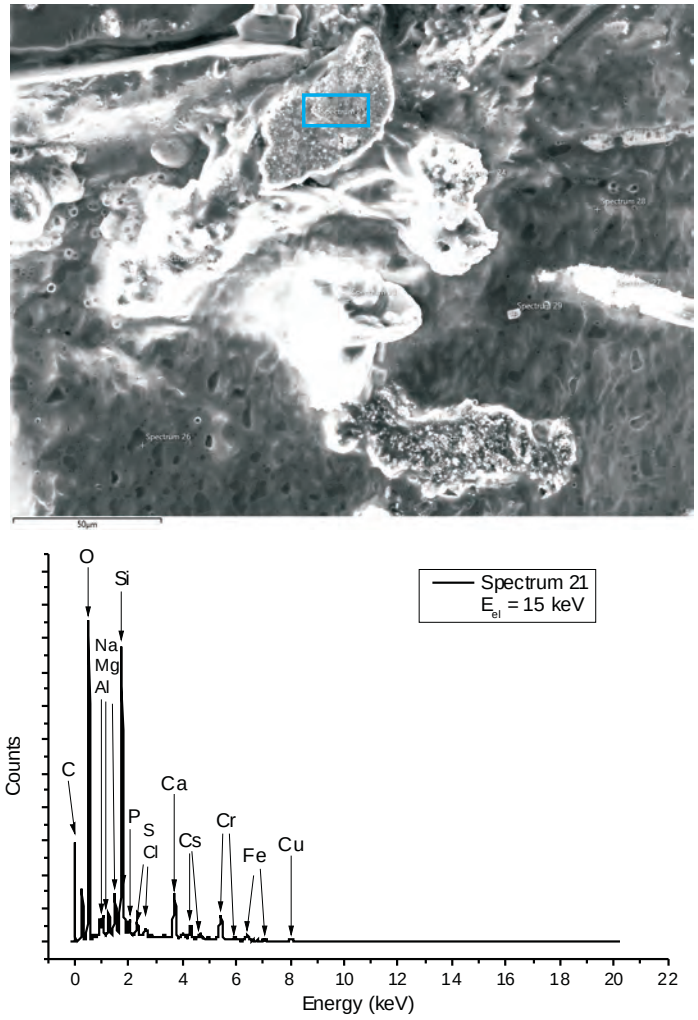

Figure 15: Top: SEM image of a particle of 50μm size. Bottom: EDX point spectrum of this particle (site 21), marked by a blue frame.

This sample was prepared via a syringe on a gold covered microscope slide as described in section 2. Figure 16 (top left) shows a SEM image of a rod like contamination. This rod like structure consists mainly of Si, some Ca and Al are also present as can be seen from the element specific spatial EDX mapping results.

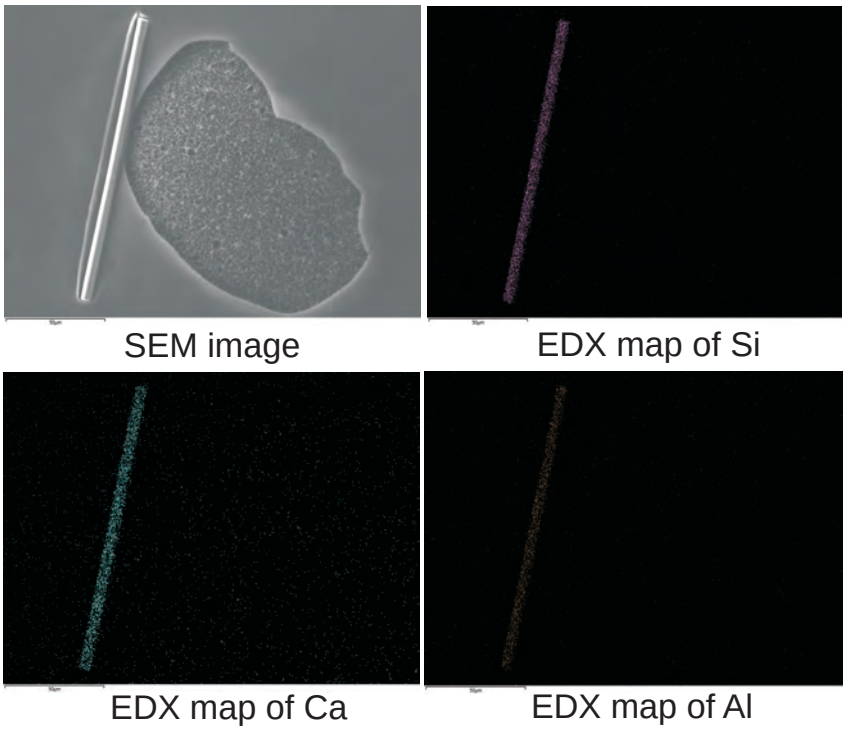

Figure 16: Top left: SEM image of a rod like structure of 20μm length. Top right: Element specific EDX mapping of Si. Bottom: element specific EDX mappings of Ca and Al.

This sample was prepared from a vial of the same lot but at another lab opening the vial and then preparing the sample as described in section 2. Figure 17 shows a SEM image of a contamination comprising significant amounts of Si, Ti, and Fe. Traces of Na, Mg, Al, K, and Ca are also detected.

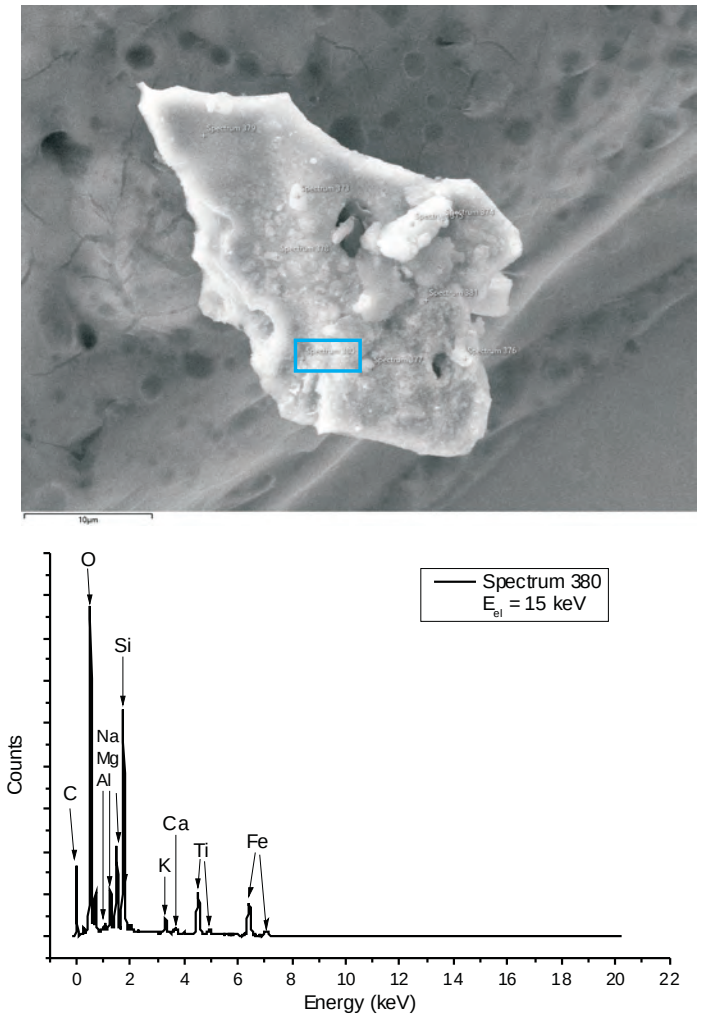

Figure 17: Top: SEM image of a particle of 15-20μm size. Bottom: EDX point spectrum of this particle (site 380), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.

This sample was prepared from a vial of the same lot but at another lab opening the vial and then preparing the sample as described in section 2. Figure 18 shows a SEM image of a contamination comprising significant amounts of Al, Si, S, and Ba. Traces of Na, Mg, S, Cl, K, Ca, Ce, Cr, and Fe are also detected.

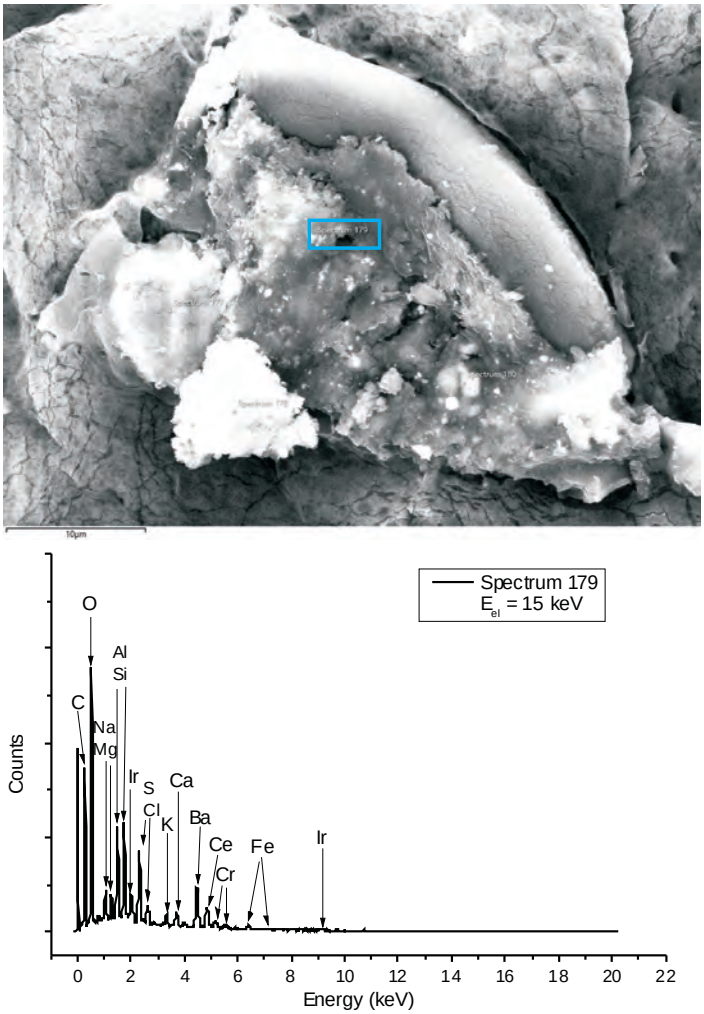

Figure 18: Top: SEM image of a contamination of 20-30μm size. Bottom: EDX point spectrum of this particle (site 179), marked by a blue frame. Note that Ir does not belong to the sample probed by EDX due to the sample preparation described in 2.